

Pb-FREE SOLDER-CONNECTED STRUCTURE AND  
ELECTRONIC DEVICE

TECHNICAL FIELD

The present invention relates to a bonded structure by a lead-free solder, in which an electronic device is bonded to an electrode of a lead frame, etc.

5 by means of the lead-free solder of low toxicity, and an electronic article with the bonded structure.

BACKGROUND ART

In order to produce an electric circuit board by bonding electric devices (e.g. LSIs) to a circuit  
10 board made of an organic material, for example, conventionally, there has been used a eutectic Sn-Pb alloy solder, another Sn-Pb alloy solder which has a chemical composition and a melting point each close to that of the eutectic Sn-Pb alloy solder, and other  
15 solder alloys which are obtained by adding small amounts of bismuth (Bi) and/or silver (Ag) to the solders recited above. These solders comprise about 40 wt% Pb and have a melting point of about 183°C, which permit soldering at 220-240°C.

20 With regard to electrodes of electronic devices, such as QFP (Quad Flat Package)-LSIs, to be soldered, there have been usually used those made of 42

alloy which is an Fe-Ni alloy and on which a layer of 90 wt% Sn-10 wt% Pb alloy (hereinafter referred to "Sn-10Pb") is formed. This is because such electrodes have good wettability, good preservation and no problem of formation of whiskers.

However, the lead (Pb) in the Sn-Pb solders is a heavy metal harmful to humans and pollution of the global environment caused by dumping of lead-containing products and their bad effect on living things have presented problems. The pollution of the global environment by electrical appliances occurs when lead is dissolved by rain, etc. from the dumped lead-containing electrical appliances exposed to sunlight and rain. The dissolution of Pb tends to be accelerated by the recent acid rain. In order to reduce environmental pollution, therefore, it is necessary to use a lead-free soldering material of low toxicity not containing lead as a substitute for the above eutectic Sn-Pb alloy solder which is used in large quantity and to employ a structure of the electrode of a device not containing lead as a substitute material to replace the Sn-10Pb layer provided on the electrode of a device. An Sn-Ag-Bi alloy solder is a promising candidate as a lead-free soldering material in terms of low toxicity, obtainability for raw materials, production cost, wettability, mechanical properties, reliability, etc. Soldering is usually performed at a temperature of

about 220-240°C so as to produce compounds between an electrode of a component and a solder, and between an electrode of a board and a solder. From this, because the bonding interfaces differs from one another

5 depending upon different kinds of combinations of solder materials and electrode materials of components, an electrode material suitable to the respective solder is required in order to obtain a stable bonding interface.

10 An object of the present invention is to provide a bonded structure by a lead-free-solder, in which a lead free Sn-Ag-Bi alloy solder having low toxicity is used for electrodes of lead frames, etc. and which has a stable bonding interface and an enough  
15 bonding strength.

Another object of the invention is to provide an electronic article with utilization of a lead-free Sn-Ag-Bi alloy solder having low toxicity, which has a stable bonding interface with respect to a change in  
20 process of time and a strength high enough to withstand stress generated in bonded portions by soldering due to a difference in thermal expansion coefficient between electric devices and a board, a work of dividing the board after soldering, warping of the board during the  
25 probing test, handling and so on.

A further object of the invention is to provide a bonded structure and an electronic article with utilization of a lead-free Sn-Ag-Bi alloy solder

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